[005] Further, examples of the prior art which have improved the gas deposition method or the electrostatic fine particle coating method stated above are disclosed in Japanese Unexamined Patent Publication No. HEI 8-81774, Japanese Unexamined Patent Publication No. HEI 10-202171, Japanese Unexamined Patent Publication No. HEI 11-21677 or Japanese Unexamined Patent Publication No. 2000-212766.

[007] In the art disclosed in Japanese Unexamined Patent Publication No. HEI 10-212171, the ultra-fine particles obtained by heating and evaporating the metal or the organic substance using resistance wire heating, electron beam heating, high-frequency induction heating, sputtering, arc plasma or the like as stated above are sprayed on the substrate through an opening of a mask. In this manner, a substance of a three-dimensional shape with no sagging shoulders is formed.

[040] A substrate forming the composite structure according to the present invention includes glass, metal, ceramic, metalloid or an organic compound. A brittle material includes the following: an oxide such as aluminum oxide, titanium oxide, zinc oxide, tin oxide, iron oxide, zirconium oxide, yttrium oxide, chromium oxide, hafnium oxide, beryllium oxide, magnesium oxide or silicon oxide; carbide such as diamond, boron carbide, silicon carbide, titanium carbide, zirconium carbide, vanadium carbide, niobium carbide, chromium carbide, tungsten carbide, molybdenum carbide, or tantalum carbide; nitride such as boron nitride, titanium nitride, aluminum nitride, silicon nitride, niobium nitride, or tantalum nitride; boride such as boron, aluminum boride, silicon boride, titanium boride, zirconium boride, vanadium boride, niobium boride, tantalum boride,

chromium boride, molybdenum boride, or tungsten boride; the compounds thereof or solid solution of a hypercomplex system; piezo-electric/pyro-electric ceramics such as barium titanate, lead titanate, lithium titanate, strontium titanate, aluminum titanate, PZT or PLZT; Extremely tough ceramics such as SIALON or cermet; living organism adaptable ceramics such as apatite hydroxide or calcium phosphate; metalloid substances such as silicon, germanium or other metalloid in which various kinds of dope substances such as phosphorus were added to silicon or germanium; or semiconductor compounds such as gallium arsenide, indium arsenide or cadmium sulfide.

[056] It is possible to control the volume resistivity value, hardness, corrosion resistance, light transmission properties and the like of the ceramic structure by the ultra-fine particles beam deposition method which changes the kind of gas and gas partial pressure stated above. Referring, for example, to the aluminum oxide, when the oxygen gas partial pressure is decreased, an optically clouded structure can be obtained, while when the oxygen gas partial pressure is increased, a transparent structure can be obtained.

[109] Operation of the above ceramic structure forming apparatus will now be described. A gas cylinder 11 is opened so that gaseous helium is introduced from the introduction section 133 of the aerosol generator 13 through the carrier pipe 12 at a flow rate of 2.5 liter/minute. As a result, the ceramic ultra-fine particle powder 132 with the internal strain is blown up within the container 132 to generate the aerosol 136. In this case, since the ceramic ultra-fine particle powder 132 is continuously supplied near an opening of the introduction section 133 by the mechanical vibration action of the vibrator

135, the aerosol 136 can be stably generated. The ceramic ultra-fine particles in the aerosol 136 which have cohered to form secondary particles can not move upward to any great extent because they are comparatively heavy. On the contrary, primary particles of low weight or comparatively small particles close to the primary particles can move upward to the upper part of the container. Accordingly, if the guide section 134 is selectively set to slide so that its position in the vertical direction can be changed, it serves as a classifier which can select ceramic ultra-fine particles of the desired particle size and guide them out of the container 131. The guided aerosol 136 is ejected from the nozzle 15 through the carrier pipe 12 toward the substrate 16 at high speed. The ejection speed of the aerosol 136 is controlled by the shape of the nozzle 15, the length and inner diameter of the carrier pipe 12, the pressure in the gas cylinder 11, the cylinder capacity of the exhaust pump 18 or the like. With these controls, for example, if the internal pressure of the aerosol generator 13 is set at several tens of thousands Pa and the internal pressure of the structure forming chamber 14 is set at several hundred Pa to provide differential pressure, the ejection speed can be accelerated from subsonic to a supersonic range. The ceramic ultra-fine particles in the aerosol 136 which have been sufficiently accelerated to build up kinetic energy collide with the substrate 16 and are fractured into pieces by the impact energy, whereby these minute fragmentary particles adhere to the substrate or join together to form a compact ceramic structure. The substrate 16 is provided with a reciprocating motion of 5 mm longitudinally by the substrate holder 17 during the structure forming operation, for 10 minutes. With this control, it is possible to form a ceramic structure of aluminum oxide of which the deposition thickness is about 50 μm. Further, if the structure forming time is extended, it is possible to increase the

deposition thickness in proportion to the time elapsed. Since this ceramic structure has almost the same hardness as a baked body, it is not necessary to further bake it by an additional heating operation or the like.

[147] Although there have been described in detail what are the preferred embodiments of the present invention, it will be understood by persons skilled in the art that variations and modifications may be made thereto without departing from the gist, spirit or essence of the invention. The scope of the invention is indicated by the appended claims.